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THE CLEVELAND MUSEUM OF NATURAL HISTORY

CLEVELAND, OHIO

JUNE 17, 1974

NUMBER 18

ADDITIONS TO THE 'CRINOID FAUNA OF THE AMES LIMESTONE, BROOKE COUNTY, WEST VIRGINIA

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ABSTRACT

Descriptions of inadunate crinoids from the Ames Limestone, Conemaugh Group, Upper Pennsylvanian, of Brooke County, West Virginia, and Guernsey County, Ohio, pertain to the following taxa: (1) *Delocrinus segedii* sp. nov. related to *Delocrinus brownvillensis* Strimple, but differing in lesser height of dorsal cup, deeper basal impression, higher extent of basals on cup walls, and smaller primanal; (2) *Appalachiacrinus erwini* gen. et sp. nov., a laudonocrinid, differing from other laudonocrinids in greater height of dorsal cup, resembling *Laudonocrinus* in flatness of infrabasals, slight upflaring of infrabasal circlet, greater width and lesser curvature of C radial, and somewhat similar axillary primibrachs, but also resembling species of *Anchicrinus* and *Athlocrinus* in convexity of basal, radial and anal plates and presence of pits at angles of plates; and (3) *Parethelocrinus occultater* sp. nov., characterized by a globose dorsal cup, with shallow and wide basal concavity, convex downflaring infrabasals, radials having prominent flat forefacets, tertanal concealed by C primibrach but partly within cup, quartanal resting on secundanal; cup ornament finely granulose.

INTRODUCTION

As indicated in a previous study (Burke, 1973), several species of Pennsylvanian crinoids from the Ames Limestone, Conemaugh Group, of Brooke County, West Virginia, are known only from the Upper Pennsylvanian of the Appalachian region. Subsequent study has determined three additional species from the Brooke County Ames, hitherto undescribed and likewise unknown beyond the confines of the Appalachian basin. These taxa, mainly represented by specimens in the collection of the Cleveland Museum of Natural History (CMNH) but in one instance also by material loaned by the Carnegie Museum (CM), are described in the following pages.

I wish to express my appreciation to Dr. John Carter and the Carnegie Museum for the loan of specimens. I am also grateful to the West Virginia Geological Survey for encouragement and financial aid in support of this investigation. Dr. N. Gary Lane of the Department of Geology, Indiana University, kindly loaned me literature pertinent to this study.

My thanks go to Mr. Bruce Frumker for the photographs from which the illustrations were taken, and to my wife, Emily, for her aid in preparing the manuscript.

SYSTEMATIC PALEONTOLOGY

Class CRINOIDEA Miller, 1821

Family CATACRINIDAE Knapp, 1969

Genus DELOCRINUS Miller and Gurley, 1890

Delocrinus segedii* sp. nov.

Figs. 1-8

Diagnosis: Dorsal cup resembles that of *Delocrinus brownvillensis* Strimble, with subround to round outline in dorsal view, characteristic curvature of lateral walls, impressed primanal, and fine granulose ornament, but cup height shorter, basal impression deeper, basals extend higher on cup walls, and primanal smaller.

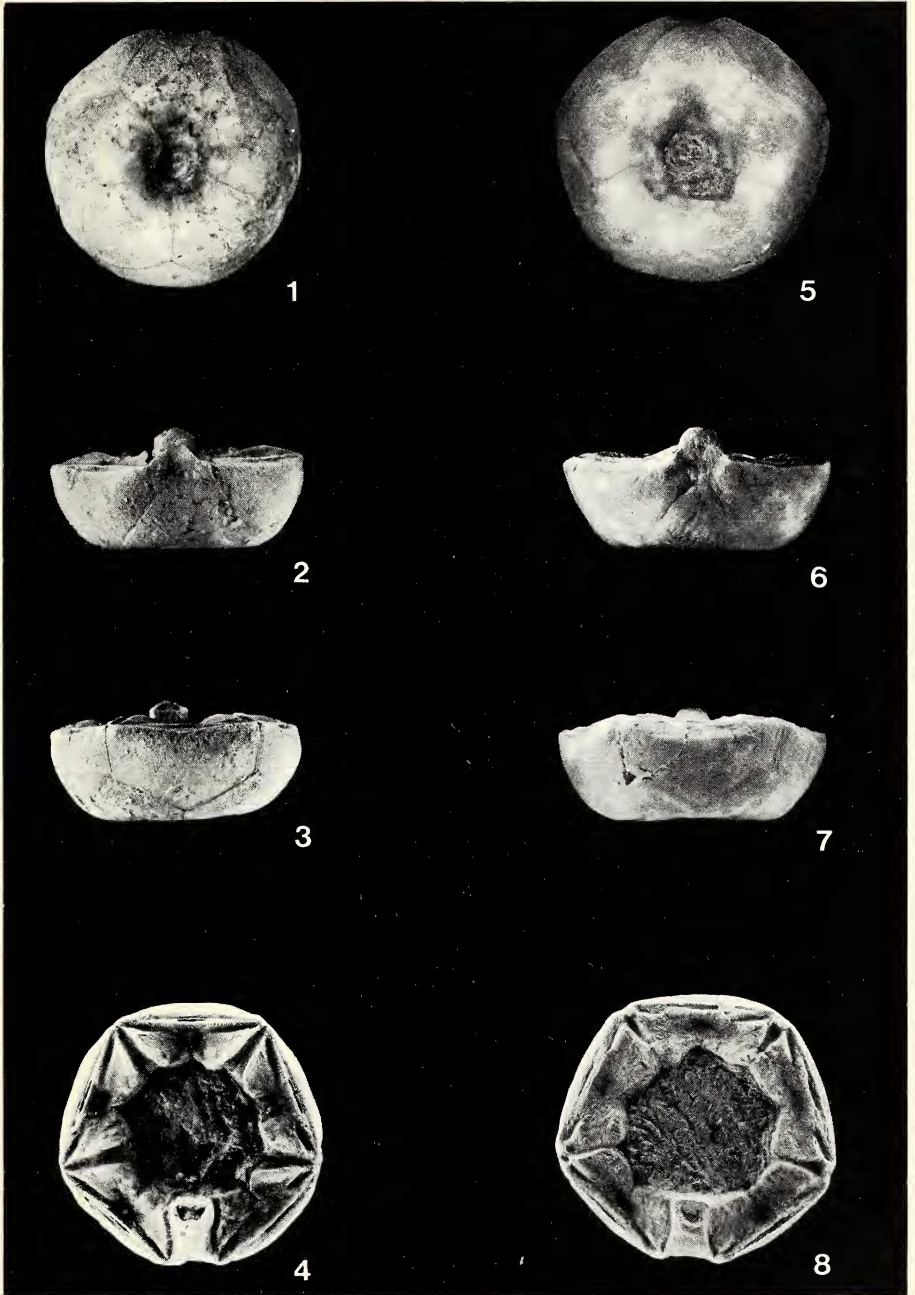
Types: Holotype CMNH 3847 (C radial damaged—restored); paratypes CMNH 3835, CM 33901 and CM 33902, all dorsal cups.

Occurrence: Ames Limestone, Conemaugh Group, Upper Pennsylvanian.

Localities: Holotype CMNH 3847 and paratype CMNH 3835 from road cut on south side of Interstate 70 and east of junction with Ohio Route 513, NW $\frac{1}{4}$ sec. 25 (lat 40° 03' 07" N., long 81° 19' W.) Oxford Township, near Middlebourne, Guernsey County, Ohio. Paratypes CM 33901 and

*Named for Mr. Robert Segedi, Science Instructor, Cleveland Museum of Natural History, who collected the Ohio specimens.

Figures 1-8. *Delocrinus segedii* sp. nov. Figs. 1-4 holotype CMNH 3847 (damaged C radial restored). Fig. 1, dorsal view. Fig. 2, posterior view. Fig. 3, anterior view. Fig. 4, ventral view. Figs. 5-8 paratype CM 33901. Fig. 5, dorsal view. Fig. 6, posterior view. Fig. 7, anterior view. Fig. 8, ventral view. All x 1.5.



CM 33902 from Tunnel Road Cut, West Virginia Route 67 (lat 40° 14' 24" N., long 80° 35' 53" W.) near McKinleyville, Brooke County, West Virginia.

Description: Dorsal cup of medium size, low truncate bowl-shaped, about $\frac{3}{8}$ as high as wide. Outline subround in dorsal view, pentagonal in ventral view. Height and width dimensions of basal impression less than half those of the cup. Stem cicatrix small. Infrabasals extend for slightly less than half the height of basal impression, steep walled proximally, sloping outward and downward distally, merging with slopes of basals without angularity. Basals with moderate downward slopes within impression, flattening, but still slightly concave at basal plane; distal slopes, along cup wall less steep, and gently convex. Tips of basals extend to about half the cup height.

Radials flare outward and upward, moderately convex longitudinally, less convex transversely. Forefacet very slight, broadly lunate. Transverse ridge and outward-facing lateral lobes visible in lateral view (barely showing in paratype CM 33901—result of compaction). Outer marginal ridge sags downward; broadly bowed in ventral view. External ligament pit slitlike, its outer ridge denticulate. Transverse ridge relatively delicate, denticulate, compressed adjacent to outer ligament pit. Lateral furrow moderately deep and broad, oblique ridge denticulate. Adsutural slopes low, but prominent, expanding widely toward body cavity, where high lateral lobes overhang them. Intermuscular notch broadly V-shaped, intermuscular furrow narrow, flanked by round-basined muscular areas.

Primanal concave from side to side in midregion; portion within the cup occupies a little less than a third of the cup height. Distally primanal slopes inward and upward; in holotype, distal facet shows small basin on each side of midline.

Ornament consists of fine granules, on primanal, radial and basal plates; not shown on proximal portions of basals of Ohio types (CMNH 3847 and CMNH 3835).

Measurements: Linear measurements in mm taken on holotype, CMNH 3847: Dorsal cup height, 8.7, width, 23.5, H/W ratio, 0.35; basal impression, height, 3.8, width 10.5; stem impression width 1.9; basal (EA) length, 9.6, width 9.4; radial (A) length, 7.8, width, 13.5; length suture between basals, 6.7; length suture between radials, 4.3; primanal height, 5.5, width 4.1.

Discussion: This species belongs to a *Delocrinus* lineage fairly well represented in Upper Missouri and Virgil sediments, characterized by dorsal cups showing granulose ornament and composed of rather massive plates which are easily damaged. The holotype, CM 3847, had most of the C radial broken away when found; the plate has been restored. Proximal portions of the basals and all of the infrabasals of the West Virginia paratypes were lost prior to deposition. I collected the latter specimens several years ago, but it was not until the better Ohio material was found that I felt that the species could be established securely.

Strimple (1949) pointed to the more rounded outline of the dorsal cup in dorsal view, coupled with the less angular longitudinal slopes of the basals, as characters distinguishing *Delocrinus brownvillensis* from *Delocrinus vulgatus*. These same features also appear to distinguish *Delocrinus segedii* from both *Delocrinus vulgatus* and *Delocrinus verus*. The height/width ratio is about the same for dorsal cups of the latter three species (about 0.35), but this ratio for *Delocrinus brownvillensis*, based on Strimple's values for height and width, is 0.39, rather than 0.35, the figure given by him. Height and width measurements of hypotype specimens of *Delocrinus brownvillensis* indicate even higher height/width ratios, up to 0.41 (Pabian and Strimple, 1973). The depth of the basal impression is less in *Delocrinus segedii* than in *Delocrinus verus* and *Delocrinus vulgatus*. The cup of *Delocrinus segedii* is ornamented; cups of *Delocrinus verus* and *Delocrinus vulgatus* are smooth.

Family LAUDONOCRINIDAE Moore and Strimple, 1973

Genus APPALACHIACRINUS* gen. nov.

Diagnosis: Dorsal cup low truncate bowl-shaped, nearly $2\frac{1}{2}$ times as wide as high. Outline irregularly hexagonal in dorsal view. Posterior interradius not impressed. Interradial notches faint. Infrabasals flat, basal and anal plates mildly convex, major portions of radials and first primibrachs swollen or bulbous. Ornament very fine irregular ridges. Infrabasal circling very slightly upflaring, not visible in lateral view. Basals curve

*The generic name is in reference to the Appalachian region where the type species was found.

downward to basal plane, then upward along cup wall. Slight pits or impressions where distal extremities of basals meet corners of radials and anals. C radial widest, least convex, with distal slopes relatively gentle. Other radials more convex with distal slopes curving inward strongly. Radial articular facets peneplenary. Primalanal, secundanal and tertanal plates in the cup, in normal arrangement. First primibrachs spinose and axillary.

Type species: Appalachiacrinus erwini sp. nov., here designated.

Appalachiacrinus erwini sp. nov.**

Figs. 9-12

Diagnosis: As for the genus—see above.

Holotype: CMNH 3834, a dorsal cup retaining four first primibrachs.

Occurrence: Ames Limestone, Conemaugh Group, Upper Pennsylvanian.

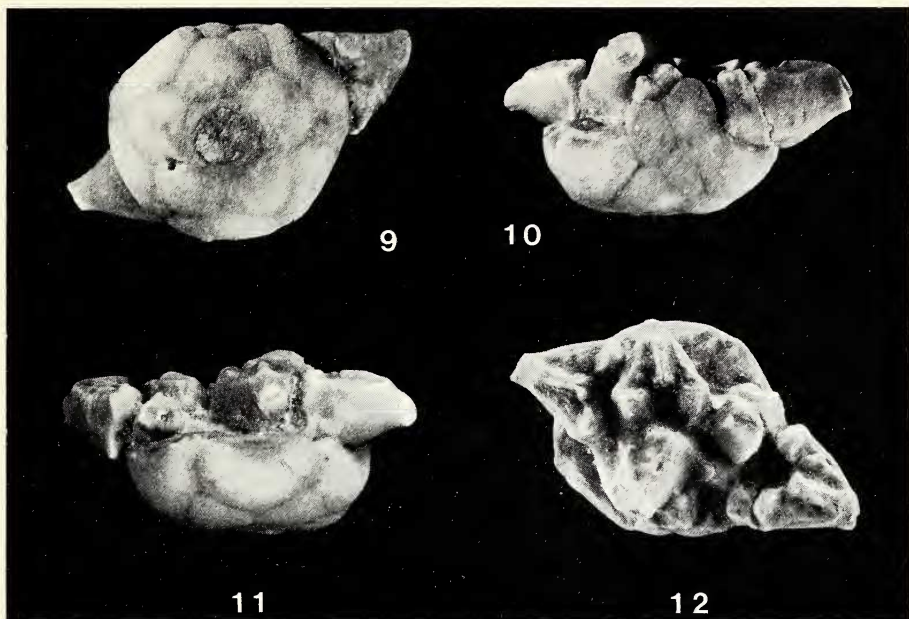
Locality: Tunnel Road Cut, West Virginia Route 67 (lat 40° 14' 40" N., long 80° 35' 53" W.) near McKinleyville, Brooke County, West Virginia.

Description: Dorsal cup low truncate bowl-shaped, nearly $2\frac{1}{2}$ times as wide as high ($H/W = 0.41$); outline irregularly hexagonal in dorsal view. Posterior interradius not impressed. Ornament very fine irregular ridges.

Infrabasal circlet nearly one-third diameter of cup, upflaring very slightly, not visible in lateral view. Stem wide, occupying most of circlet; closely surrounded by infrabasals. Infrabasals flat, with wide distal angles; distal surfaces flush with those of basals along common sutures. Basals gently convex, sloping downward from contact with infrabasals and then upward along cup wall. Slight pits where distal terminations of basals meet corners of radial and anal plates.

C radial widest and least convex of radial plates; distal slopes fairly gentle. Remaining radials bulbous; least convex from side to side; distal

**The specific name is in honor of Dr. Robert B. Erwin, State Geologist of West Virginia.



Figures 9-12. *Appalachiacrinus erwini* gen. et sp. nov. Holotype CMNH 3834. Fig. 9, dorsal view. Fig. 10, posterior view. Fig. 11, anterior view. Fig. 12, ventral view. All x 3.

slopes curving inward sharply in relatively broad areas defined by strongly arcuate forefacets. External surfaces slightly impressed in notches at summits of interradian sutures; articular facets peneplanary and moderately declinate. External marginal ridge bowed, sags downward and faces outward together with slitlike external ligament pit. Transverse crest low, denticulate; lateral furrows broad, shallow. Adsutural slopes gentle but extensive. Internal notch V-shaped; muscle area basins round.

Primanal, secundanal, and tertanal gently convex; arrangement normal. Two additional multifaceted anal plates present but dissociated.

First primibrachs axillary; all except B primibrach preserved. Plates spinose, major portion bulbous, not compressed from side to side. Spines arise high on plates, tips not preserved. Strong ridge separates right and left facetal areas. A single short secundibrach with part of articular surface facing outward rests on the dorsal faces of the secundanal and tertanal. It shows a wide V-shaped intermuscular notch and what appears to be a short intermuscular furrow flanked by shallow basins on each side.

Measurements: Linear measurements, in mm, taken on holotype, CMNH 3834: Dorsal cup height, 4.4, width 10.7; stem width, 2.2; infrabasal circlelet width, 3.4, basal (AB) length, 2.8, width 3.5; radial (A) length 3.5, width 5.6; length suture between basals, 1.0; length suture between radials, 2.2; primanal length, 3.2, width 1.7; secundanal length, 2.9, width 2.3; tertanal length 3.0, width, 2.2; first primibrach (E) length along lateral suture, 2.5, width 4.9.

Discussion: This interesting little crinoid bears resemblances to *Laudonocrinus*, *Anchicrinus*, and *Athlocrinus*. The flat infrabasals and very slightly upflared infrabasal circlelet are also features of *Laudonocrinus*, but *Appalachiacrinus erwini* differs from *Laudonocrinus subsinuatus* in not showing the infrabasals in lateral view. As in *Laudonocrinus*, the C radial is the widest and least convex, but the radials generally differ from those of *Laudonocrinus* in being for the most part bulbous, although steep walled distally. The axillary primibrachs are perhaps more like those of *Laudonocrinus* than those of any other laudonocrinid genus, but they are tumid and not compressed from side to side as in *Laudonocrinus subsinuatus*.

However, no other laudonocrinid genus approaches *Appalachiacrinus* in cup height. It resembles *Anchicrinus* and *Athlocrinus*, which have much shallower cups, in the convexity of its cup plates, in showing pits at the plate angles, and in the lack of an impressed posterior interradius, such as characterizes some species of the latter genera.

Family CROMYOCRINIDAE Bather, 1890

Genus PARETHELOCRINUS Strimple, 1961

Parethelocrinus occultator* sp. nov.

Figs. 13-15

Diagnosis: Cup less than three times wider than high, constricted at summit, basal impression shallow and wide, infrabasal circlelet relatively large, downflaring. Sutures impressed, ornament finely granulose. Radials with prominent flat forefacets. Primanal, secundanal, and lower right corner of tertanal in cup, quartanal rests on secundanal, not in cup. Tertanal concealed by C ray primibrach.

*From the Latin *occultator* (concealer) in reference to the hidden tertanal.

Holotype: CMNH 3833, a crushed dorsal cup with three axillary primibrachs, one preserving portions of arms.

Referred specimen: CMNH 3802, associated cup and arm plates, including an axillary first secundibrach.

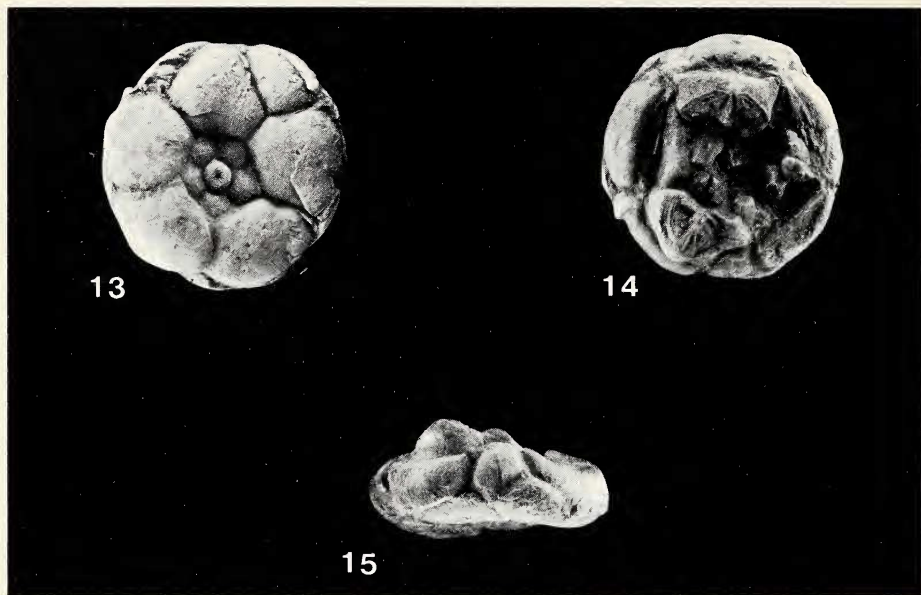
Occurrence: Ames Limestone, Conemaugh Group, Upper Pennsylvanian.

Locality: Tunnel Road Cut, West Virginia Route 67 (lat 40° 14' 24" N., long 80° 35' 53" W.) near McKinleyville, Brooke County, West Virginia.

Description: Dorsal cup low truncate globe-shaped. Cup of holotype crushed, but must have been less than three times as wide as high. Basal impression shallow and wide, infrabasal circle relatively large. Sutures between cup plates in shallow V-shaped impressions; ornament very finely granulose.

Stem prominent; infrabasals convex, downflaring. Basals gently convex within basal impression, with moderate outward and downward slopes to junction with radials; strongly convex beyond that region, curving abruptly upward along outer wall of cup. Radials moderately convex, widest at proximal lateral angles. Forefacets prominent in ventral view, flattened. External ligament pit slitlike. Transverse ridge of moderate height and denticulate. Internal notch V-shaped; intermuscular furrow narrow. Muscle areas with shallow curved grooves.

Three anal plates in cup. Primanal large, quadrangular; secundanal medium sized, pentagonal, its left side almost straight and nearly vertical in arrangement, meeting D radial and D primibrach; bears quartanal dorsally, extends in V-shaped angle to right, meeting with C radial above and making very wide contact with primanal below; narrow proximal side abuts against truncate CD basal. Surface exposure of quartanal slight, plate bent inward, expands laterally to left and right in direction of body cavity, contacts D first primibrach on left, firmly bound to tertanal at right. Sides of tertanal and quartanal directed inward on the right, bounding left side and corner of C primibrach. Tertanal sinks slightly below left lateral lobe of C radial and consequently is within cup, but entire plate would be concealed in external view if C first primibrach were in place. Distally, quartanal and tertanal bear facets for two additional tube plates. Another anal plate lies nearby in body cavity.



Figures 13-15. *Parethelocrinus occultator* sp. nov. Holotype CMNH 3833. Fig. 13, dorsal view. Fig. 14, slightly oblique ventral view. Fig. 15, posterior view. All x 1.

First primibrachs D, E, and A present; plates short in height, massive, showing prominent forefacets proximally and having rounded tips that project outward distally. Articular surfaces robust, transverse crests of both articular faces of the A plate very strongly and broadly denticulate, suggesting that this primibrach bore axillary secundibrachs. A single axillary secundibrach is associated with plates of the referred specimen, CMNH 3802, indicating that this species had more than 10 arms.

The E primibrach bore two arms; it retains a single first secundibrach of the left ray and three secundibrachs of the right ray. These plates appear to have attained biseriality on the second secundibrach. Isolated secundibrachs show flat lateral sides, prolonged in typical ethelocrinid fashion.

Measurements: Linear measurements, in mm, taken on holotype, CMNH 3833: Dorsal cup height, 13.0*, width, 34.0*; width stem, 4.0; width infrabasal circlet, 11.3; basal (EA) length, 11.9, width, 15.5; radial (E) length, 9.2, width (proximal lateral angle), 16.8, width (summit), 13.8;

length suture between basals, 8.7; length suture between radials, 4.6; primanal length, 12.0*, width, 11.0*, secundanal length 9.0, width 7.0*, quartanal length, 4.5, width 5.0+; axillary primibrach (A) length (along lateral suture) 5.0, width 13.8.

Discussion: In general, the dorsal cup of this species appears more like that of *Parethelocrinus magnus* (Strimple) than any other ethelocrinid species (cf Strimple, 1949, pl. 2, fig. 1, 3, 5, 6). The basal concavities and infrabasal circlets are much the same in the two species, and in ventral view the prominent flat forefacets of the radials are strikingly alike. Even the shallow grooves of the radial muscle areas appear the same in both taxa. *Parethelocrinus magnus* also shows an inward extension of the tertanal along the left lateral side of the C radial; this is the same region where the tertanal of *Parethelocrinus occultator* is found, but the tertanal and quartanal were not joined in the Strimple species and both plates articulated with the secundanal.

In a dorsal cup of *Dicromyocrinus geminatus* (Trautschold) figured by Yakovlev and Ivanov (1956, pl. 4, fig. 3) the tertanal occupies essentially the same position as in *Parethelocrinus occultator*, and probably would not have been visible in lateral view if the C primibrach were in place. However, in the Russian specimen, the tertanal is evidently a separate plate wedged in between the C radial and the secundanal. The quartanal is not shown. In the holotype of *Parethelocrinus occultator*, the quartanal and the tertanal are very closely joined and I cannot find clear evidence of sutural separation. If the two plates are fused, this may be an abnormal condition. On the other hand, the position of the tertanal is such that fusion with the quartanal would contribute to its function as a supporting plate.

*Estimated.

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MANUSCRIPT SUBMITTED MARCH 19, 1974